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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/059,176	01/31/2002	Hirokazu Hayashi	OKI.298	7695

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EXAMINER	
SAXENA, AKASH	

ART UNIT	PAPER NUMBER
2128	

DATE MAILED: 08/24/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/059,176	HAYASHI, HIROKAZU	
	Examiner	Art Unit	
	Akash Saxena	2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 May 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7* is/are rejected.

7)☒ Claim(s) *8 and 9* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Claim(s) 1-9 has/have been presented for examination based on amendment filed on 30th May 2006.
2. Claim(s) 1,3, 5-6 and 9 are amended.
3. Previous non-final office action mailed on 27th February 2006 is incorporated within this office action unless otherwise specified where the more current rejection for the amended claims supercedes the previous rejection.
4. The arguments submitted by the applicant have been fully considered. Claims 1-9 remain rejected. The examiner's response is as follows.

Response to Applicant's Remarks & Examiner's Withdrawals

5. Please response to arguments for rejections made under 35 USC 112 and 35 USC 103.
6. Claims 8 and 9 remain objected to.
7. This action is made Final.

Response to Applicant's Remarks for 35 U.S.C. § 112

8. Claims 1-8 were rejected under 35 USC 112 second paragraph.

Regarding Claim 1

Examiner withdraws the objection in view of applicant's amendment to the claim language and support presented in specification for the amendment (Specification: Pg.11 Lines 23-37).

Regarding Claim 7

Examiner respectfully maintains the rejection for claim 7. There is no distinction in the specification being pointed out (or understood by examiner) between the BOX-Insulating layer and gate oxide layer (also an insulating layer). Further, composition of BOX insulating layer is not defined in the specification. To confuse the mater further, applicant does not even claim BOX-insulating layer. Claim defines "another insulting layer".

Further, claim discloses "setting data of another insulting layer deposited on a side of said Si layer opposite to said SiO2 layer". As expressed above the meaning of other insulting layer is still unclear, as even if its understood as BOX insulting layer is indefinite. Examiner further fails to understand if this limitation should be read as Si layer being sandwiched between two SiO2 layers vertically or if the Si layer and the other two layers lie in the same plane.

Further MPEP 2106 states:

> Limitations appearing in the specification but not recited in the claim are not read into the claim. E-Pass Techs., Inc. v. 3Com Corp., 343 F.3d 1364, 1369, 67 USPQ2d 1947, 1950 (Fed. Cir. 2003) (claims must be interpreted "in view of the specification" without importing limitations from the specification into the claims unnecessarily). In re Prater, 415 F.2d 1393, 1404-05, 162 USPQ 541, 550-551 (CCPA 1969).

Regarding Claim 8

Examiner withdraws rejection in view of applicant's amendment to claim 8.

Response to Applicant's Remarks for 35 U.S.C. § 103

9. **Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over KU '717, in view of LI'1999.**

Regarding Claim 1

Applicant has argued that KU'717 does not disclose setting data of a position of a source or a drain and also clearly fails to disclose calculating the amount of said impurity as further featured in claim 1.

Examiner agrees that KU'717 does not teach the above-cited limitation. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). LI'1999 reference was used to teach the above-mentioned limitation. LI1999 not only teaches setting data of a position of a source or a drain (LI1999: See Fig.1), but also teaches functionally identical determination of the amount of impurity in each of the cells as an impurity density function of distance r1 and r2 related to drain and source, as featured in claim 1 (LI'1999: See **Fig.1 impurity distribution (N) in x and y direction**).

To this effect, examiner admits the distribution is not disclosed in terms of r1 and r2 as featured in the claim, however if the impurity density function in x and y domain is given in view of source and drain then impurity density can be determined at any position in the mesh. Mere transformation of the co-ordinate system is a mathematical manipulation of the already available density function. See examiner's

illustration below where r (r1 or r2) can be expressed in for on X & Y position and the impurity distribution N is presented with respect to X & Y.

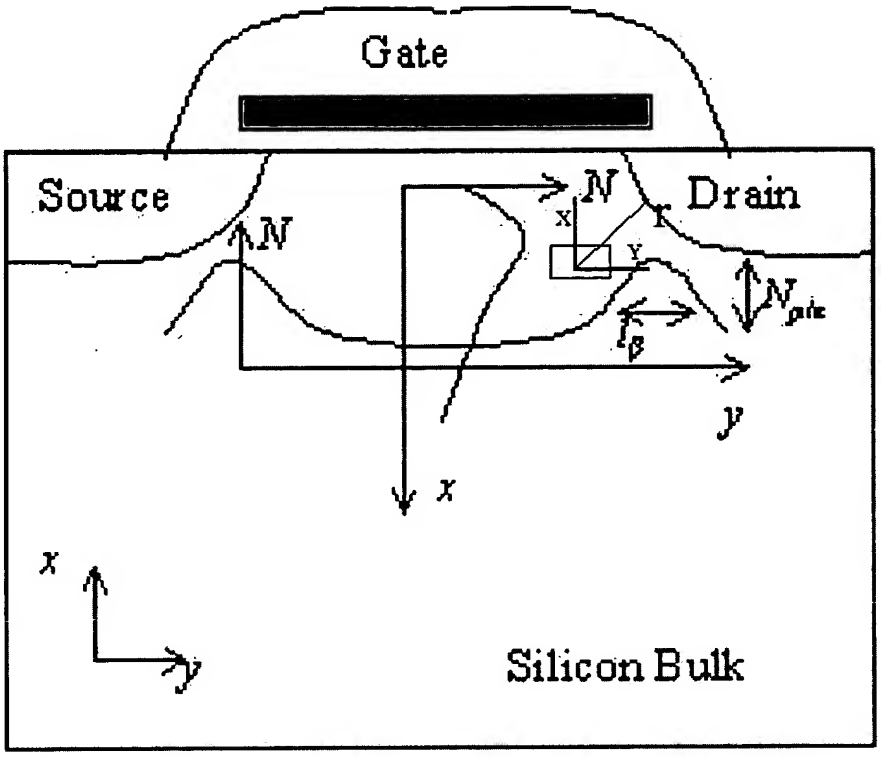

Fig. 1: MOSFET with both vertical and horizontal non-uniform doping profiles.

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a

reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). Here mere transformation in the co-ordinate system does not constitute an impermissible hindsight, in fact this representation is graphical view of a impurity density function and would be known to one skilled in the art of mathematical co-ordinate representation.

Further, applicant has argued that the two distances r1 and r2 were used to arrive at the impurity density. Again, this is just a mathematical representation as illustrated below.

r1 = (x1, y1) (distance r1 can be decomposed in form of x1 and y1 in X & Y co-ordinate system as presented in LI'1999 Fig 1). Similarly r2 = (x2, y2).

Adding X and Y components yields exact x and y positions in the X-Y co-ordinate systems, i.e. x = x1 + x2; y = y1+y2 and provided the graphs of X-*vs*-N (X position verses Impurity density function graphs in fig 1) and Y-*vs*-N (Y position verses Impurity density function graphs in fig 1) one can mathematically compute the impurity density at any point relative to the distance r1 and r2.

This illustration is only exemplary and can also be made in various other co-ordinate systems (solid angular representation, rotating the X-Y verses N graphs etc).

LI'1999 does not disclose these other obvious variations however these mathematical co-ordinate representations are known in the mathematical arts and would be obvious to one skilled in the art of mathematical co-ordinate representation.

Applicant's argument regarding establishing a prima facie case of obviousness are considered and are found to be unpersuasive.

Regarding Claim 2

Arguments presented against claim 2 rejections are addressed above.

Regarding Claim 3

Although examiner had taken official notice, reference pertaining to definition of solid angle was provided with the previous office action. The mathematical concept of solid angle was to calculate the impurity flux from a given surface (for example cell interface). Applicant's disclosure admits that this concept is well known in the art. See specification Pg. 15:

> The following method is an example of a calculation method of the solid angle $\Delta\theta$. First, a side (a) of the interface cell 124 in the interface, side (b) connecting one of two ends of the side (a) to a representative point of the cell 122, and side (c) connecting the other end of the side (a) to the representative point of the cell 122 are calculated.
>
> Subsequently, the sides (a), (b), and (c) are used to calculate the solid angle $\Delta\theta$ by the following equations.
>
> $\Delta\theta = ATAN(r/(p-a)$
>
> $p = 0.5*(a+b+c)$
>
> $r = r1^{(1/2)}$
>
> $r1 = (p-a)*(p-b)*(p-c)/p$
>
> (*quoted from p.174 of "Basic Mathematics Handbook" authored by Miyamoto, et al., published by Morikita Shuppan, 1990)

As presented earlier in the rejection using KU'717 reference teaches calculating the impurity flux through a surface related to phenomenon of diffusion and pileup (KU'717: Col1 Line 65- Col.2 Line 5).

KU'717 also presents the impurity flux based on the discretized mesh points projected to calculate the impurity flux at a distance d (See Eq. 7a-7f). Solid angle used in the specification performs the same function when a point is selected within the cell 122 and impurity flux based on this cell is computed at the interface of cell 124 (Specification: Fig.4). Although solid angle is not used in KU'717, the impurity flux through a surface is computed. The solid angle is proportional to the surface area, S, of a projection of that object (here the impurity interface/point) onto a sphere centered at that point, divided by the square of the sphere's radius, R. (Symbolically, $\Omega = k\, S/R^2$, where k is the proportionality constant.).

In response to the official notice, examiner is providing the Definition of Solid angle and practical applications related to it (for example in defining luminous intensity – *flux* and *boundary element method* both of which pertain to instant disclosure). It is shown above how the Solid angle can be used to meet the limitations of claim 3 by one of ordinary skill in the art. Examiner therefore asserts that since the claim does not exactly claim equation 6 & 7, as presented in the specification, the claimed limitation in claim 3 are taught by the teachings of flux calculation based on a point and impurity pileup in a functionally equivalent form by KU'717.

Regarding Claim 5

Arguments presented against claim 5 rejections are addressed above in claim 1 rejection.

Amended Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

10. **Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,154,717 issued to Shingetaka Kumashiro (KU '717 hereafter), in view of Journal of Modeling and Simulation of Microsystems article "Physics-Based Threshold Voltage Modeling with Reverse Short Channel Effect" by K-Y Lim (LI 1999 hereafter).**

Regarding Claim 1

KU '717 teaches (preamble & steps (a)(b)) a method of modeling semiconductor device process (KU '717: Col.1 Lines 7-14) by setting data for the SiO2 and Si layers brought in contact with each other (KU '717: Col.19 Lines47-48; Col.6 Lines 56-59). Further, KU '717 teaches (step (c)) setting plurality of cell in a layer (a mesh) with amount of impurity in each cell (KU '717: Col.19 Lines 52-57; Col.6 Lines 42-45). Further, KU '717 teaches (step (d) & (e)) setting diffusion rate on the impurities from one cell to another (KU '717: Col.19 Line 48) and setting up impurity pileup portion in a cell at the interface of SiO2 and Si (KU '717: Col.6 Lines 60-62).
Further, KU '717 teaches (step (g)) calculating the amount of impurity included in each cell after performing above-mentioned steps (KU '717: Col.6 Lines 63-64).

KU '717 does not teach step (f) explicitly.

LI 1999 teaches source and drain edges contributing to the reverse short channel effect and thus the affecting the impurities (LI 1999: Pg.52 Col.1 Lines 3-6). It would be obvious necessity to know the position of source and drain. *Further, LI 1999 teaches that the rate of diffusion for the impurities is shown to be function of two distances (LI 1999: Fig.1 Pg.52, Equation 1-2). LI teaches new limitations*

amended, i.e. "mass of impurity in each cell" (as effective pileup concentration) determined by "impurity density function" (Fig.1) as a function of r1 and r2.

It would have been obvious to one (e.g. a designer) of ordinary skill in the art at the time the invention was made to apply the teachings of **LI 1999** of **KU '717** to create a model of semiconductor device. The motivation to combine would have been that **KU '717** is simulating the impurity pileup in a semiconductor (KU '717: Abstract) and LI 1999 teaches to model the cause of the impurity diffusion by building joint vertical & lateral model for the phenomenon resulting from impurity pileup (LI 1999: Pg.51, Col.1 Lines 12-21; Pg.56 Conclusion).

Regarding Claim 5

LI 1999 teaches considering the positions of source and drain as channel length and then position relative to the cell as distance y from each of them. However, KU '717 teaches modeling a semiconductor without explicit knowledge of the position of the source or drain (KU '717: Col.1 Lines 7-14). Combining these references will effectively ignore the positions of specified drain(s).

Regarding Claim 6

LI 1999 teaches storing data for magnitude the reverse channel effect and expressing the threshold voltage based on the impurity concentration (LI 1999: Pg.52 Equations 1, 2, 3, 3(a), 3(b), 3 (c)). The amendment calculates the threshold voltage using impurity amount calculated (i.e. Neff) from equation 3(c) specifically.

Regarding Claim 7

KU '717 teaches a method of modeling semiconductor device process (KU '717: Col.1 Lines 7-14) by setting data for the SiO2 and Si layers brought in contact with each other (KU '717: Col.19 Lines47-48; Col.6 Lines 56-59). Another insulting layer is interpreted as SiO2 layer. The amended limitation does not clarify the claimed limitation (See 35 USC 112 rejection) therefore the interpretation is maintained and rejected as earlier.

Allowable Subject Matter

Regarding Claim 8-9

Claims 8 & 9 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 8-9 are objected to as they present limitations not taught by either KU '717 or LI 1999. KU does not teach the limitation of providing the exact impurity functions for based on r1 and r2 as featured in claim 8.

The distinguishing feature from LI'1999 is that LI'1999 discloses a positive exponential relation between the impurity (Np(Y)) with respect to characteristic length. Although characteristic length may be understood as lamda in featured claim, the *exponential relation in LI'1999 is squared* (unlike current claim) and *decay is positive* (unlike negative exponential decay in current claim).

The functions r1 and r2 as exactly defined are found to be novel over prior art. The distances y and Leff are in the same direction and the r1 and r2 expressions are not multiplied by each other to yield the mass of impurity (Claim 9) by either KU '717 or LI 1999 combined.

U.S. Patent No. 6,581,028 by inventor (Hayashi) & same assignee, discloses similar exponential expressions for r1 and r2 (Fig.6), but the definitions of the terms x & y in the patent corresponding to r1 and r2 in instant application are different. X (distance from gate end in the direction of the channel length), y (distance from channel interface in the direction of channel depth) are different from r1 (distance from pileup

position) and r2 (distance from source or drain). Also the terms are not multiplied together to obtain the mass of said impurity moving.

Effectively, if the independent claims of the current application are presented in the similar manner as Patent No. 6581028, expressly claiming the present invention in the equation format (Specification: Pg. 12Eq: 2), the claim may be allowable over prior art of record used.

Conclusion

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Communication

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Akash Saxena whose telephone number is (571) 272-8351. The examiner can normally be reached on 9:30 - 6:00 PM M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamini S. Shah can be reached on (571)272-2279. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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